GAS POWERED AIR CONDITIONING
ABSORPTION vs. ENGINE-DRIVE

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ABSTRACT

It used to be that the only alternative to costly electric air conditioning was the double-effect gas-fired absorption chiller/heaters. Beginning in the 1980's, they were the "star" equipment promoted by gas companies throughout the nation. Although not a new technology at the time, neither was the gas engine. But now in the 1990's, gas engine-drive (GED) chillers have "hit" the air conditioning market with a "bang". In the Lone Star Gas Company area in 1995, GED chillers are now being considered in as many projects as are Absorption. units. Where once the only studies being analyzed were absorption vs. electric chiller operation costs. Now, the choice is: Why, Where, and How to choose between gas fired Absorption and GED chillers.

WHY Absorption or Engine ?

- Absorption uses the most environmentally friendly refrigerant - water.
- Absorption chillers are chiller/heaters
- Absorption chillers are manufactured by the
- Engine chillers provide "free" hot water
- Engine chillers retrofit with DX systems
- Engine chillers use less gas per ton

WHERE Do Absorption And Engine Chillers Belong?

- Absorption: Office buildings, restaurants, industries, churches, universities
- Engine: Hospitals, universities, hotels, apartments, industries

HOW To Choose Between Absorption And Engine Chillers?

- Energy cost
- Operation and maintenance costs
- Equipment cost
- Environmental concerns
- Thermal requirements
- Space requirements
- Staff experience

A DESCRIPTION OF THE SYSTEMS

The absorption chiller uses the cooling effect of water evaporation to cool a facilities water cooling system while the gas engine drive chiller uses a standard "freon" compressor driven by a gas engine to provide its cooling. In the absorption chiller, a heat generator boils the water out of a dilute solution of LiBr, a salt, resulting in steam and a concentrated solution of LiBr. In a double effect absorption chiller the hot steam is used to drive still more water out of solution. Both portions of steam are then cooled in the condenser, passed through a metering valve into a low pressure chamber where the water evaporates and cools the water in the coils serving the facility. The low pressure is created by the affinity of the concentrated LiBr solution in the absorber for the water in the evaporator section. A pump then moves the dilute solution back to the generator to continue the process.

GED chillers are no different than their electric counterparts except an engine drives the compressor

to the shaft for mechanical energy and 20% is lost as radiant heat, there is still 50% of the energy, as thermal energy, left for useful purposes. This thermal energy may be used for domestic hot water, space heating, or process hot water or low pressure steam requirements without the input of any extra energy source.

WHY ABSORPTION OR ENGINE

Absorption chillers use the most environmentally friendly refrigerant - water. There is no need to worry when the next "freon" is to be banned from use or how much more it will be taxed to discourage its usage or how inefficient it may make the compressor. With Absorption. chillers, there is no requirement to report intentional or unintentional leaks that damage the atmosphere. If the water refrigerant or the LiBr solute leaks, there is no damage to humans or the planet.

Another advantage of Absorption chillers is that they have few moving parts. The major parts of an Absorption. chiller are a burner, lots of copper piping, electronic controls, heat exchangers, and a solution and refrigerant pump (two moving parts only). With a changeover valve, Absorption chillers are both a chiller and a hot water heater. By bypassing the condenser section of the chiller, the steam generated in the first stage generator is sent into direct contact with the water coils from the facility being served and hot water is produced for space heating from the chiller/heater. To produce cooling, steam from both the first and second stage generators is condensed and then introduced into the low pressure evaporator section where it evaporates and chills the water in the chilled water coils for facility air conditioning or process cooling. Thus, Absorption chillers are chiller/heaters. Several models are designed to provide simultaneous cooling and heating where part of the steam is sent to hot water coils in a separate compartment and part to the chilled water coils in the evaporator section.

Absorption chillers are manufactured by the four US major manufacturers, York, Trane, Carrier, and Sanyo-Bohn. As of this writing York's Absorption chillers are manufactured in Houston, Texas and Trane's are manufactured in LaCrosse, WI. The Carrier Absorption units are manufactured in Mexico and the Sanyo-Bohn units are made in Japan. Having these major manufacturers making Absorption chillers means a large trained and competent sales and service force to support the equipment.

Gas engine drive chillers use less energy per ton to operate than the Absorption units. An Absorption chiller uses 11 to 12 cubic feet of natural gas per ton-hour while the GED chillers use 8.5 to 10 cubic feet of gas per ton-hour. This is a savings of approximately 2,250 cuft of gas per hour on a 1,000 ton chiller and a $6.75 savings per hour, $14,850 in a normal year's cooling.

Another advantage of GED chillers is their ability to provide "free" hot water. Since the energy used to power the engine is economically allocated to the cost of cooling through the compressor, the "waste" heat rejected by the jacket water and the exhaust can be considered "free" if a useful purpose is found for it. This is an economic advantage of the GED chiller over the Absorption. chiller. If a million Btu's/hr of hot water can be used from the heat of the engine, at $3.00/Mcf for gas, an extra $6,600 can be saved in facility energy operations each year.

Since Absorption. chillers are only applicable in chilled water systems, the ability of the GED chillers to retrofit with DX systems gives them the advantage of competing against electric DX systems. Since the GED's compressor is the same as the electric motor driven system's, no modifications are needed in system design as would be required if the system was changed to chilled water. GED chillers come in sizes down to 15 tons for commercial and 3 tons for residential. The Absorption. chillers minimum size for a high efficiency unit is 30 tons. GED units can be easily roof or pad mounted and do not require a water tower for condenser cooling. All Absorption. units require a condensing water tower and its extra maintenance; another advantage for GED chillers.

WHERE DO ABSORPTION AND ENGINE CHILLERS BELONG

Absorption chillers are applicable for office buildings, restaurants, industries, churches, and universities. The common characteristic of these facilities is their need for space cooling and heating, either as the seasons change or simultaneously in large multi-zoned buildings. Buildings that do not need large quantities of domestic or process hot water are good candidates for Absorption. chillers.

GED chillers are applicable for hospitals, universities, hotels, apartments, industries, and any other application where domestic or process hot water or low pressure steam is also required. Preferably, the thermal energy and the cooling should be needed at the same times; otherwise, hot water storage tanks are required.

Since both systems are generally unfamiliar with maintenance staffs, training is generally required. The GED system requires oil, filter, and spark plug replacement on a periodic schedule. Absorption chillers require purging and an understanding of its operation.

HOW TO CHOOSE BETWEEN ABSORPTION AND ENGINE CHILLERS

Several areas should be considered when trying to choose the right chiller for the project. What does it cost to purchase the equipment? Both Absorption and GED chillers cost approximately the same, between $400/ton and $1000/ton depending on size. In the large sizes (over 700 tons) and the small sizes (30 tons to 100 tons), the Absorption. chiller is

generally a little cheaper than the GED chiller. In the mid size ranges, it is a "push" and the lower price is determined by the manufacturer who wants the job the worst. Generally the costs are in the $550/ton to $700/ton range.

As stated earlier, energy costs favor the GED chiller since it uses less gas consumption per ton than the Absorption chiller. Operation costs favor the Absorption chiller because of its few moving parts. The GED chiller requires standard maintenance of the compressor plus engine maintenance of oil, plug, and filter changes on a regular basis and an engine overhaul every 40,000 hours or so. In smaller tonnage units, where the GED chiller is air cooled, it does have the advantage of not having to maintain a water cooling tower and water pumps when it is used in a "DX" system.

Other areas to be considered are space requirements and staff experience. Since both systems come in a variety of sizes and in the smaller sizes are weatherproofed, it is hard to provide a preference without actual site plans. In general, Absorption. chillers are generally taller than GED chillers. GED chillers are generally wider and both are about the same length. The exception being the Yazaki chiller which averages about six-foot square and seven and a half feet tall. Although absorption chillers are not a new technology, many plant and facility engineers and maintenance people have not had any experience with the operation of them. Actual operation is as easy or easier than an electric system but personnel need to be trained. Different noises need to be recognized as standard so that when a different sound or pitch is heard, they are able to look for the cause. GED chillers require little or no extra training than an electric chiller. A reciprocating compressor and an engine are very similar in operation. The typical HVAC mechanic, with minimal training, can do standard maintenance on an engine. Again the sound of an engine has a different pitch than a motor and personnel must become accustomed to it.

If there are hot water or low pressure steam needs, the GED chiller should be considered first.

Environmentally, both systems meet all Federal and State standards. To date, no GED or Absorption chiller has been rejected from a project due to environmental regulations. If an individual is concerned about any and all "freons", then the Absorption chiller should be considered first. If NOx production is a concern on the engine chiller, lean burn engines are available and exhaust catalytic systems can be added. Both systems have lower source pollution than an electric chiller.

CONCLUSION

Solid answers to the above questions (Why? Where? How?) will help you choose which gas-fired system is correct for your application. Always have an operation cost analysis run before choosing a chiller. Talk to others who are using the equipment you are considering. Do not accept "the old standard design"; make sure your engineer and architect have considered all alternatives. When in doubt, contact your gas company technical representative for assistance in all your gas choices.